Memorandum

FROM: Megan Lynn Tucker

SUBJECT: Report on research resources and interest areas for physics

This document describes research resources and a research interest area for professionals in physics. This document begins with background information on physicists, followed by a description of research resources, discussion of research materials, and research applications.

Background Information

Physicists perform computational and experimental research within the physics discipline. Alternatively they may pursue cancer prevention and diagnosis in the biomedical field, performing data analysis as computer scientists, or modeling economic systems for banks.

Many physicists in the nuclear engineering and plasma physics fields are researching ways to optimize efficiency and minimize the thermal waste of helium reactors[1].

Research Resources

A research database was used to find papers from peer reviewed journals about recent helium reactor research.

Database

arXiv is an online database containing papers in the physics, mathematics, computer science, quantitative biology, quantitative finance, and statistics disciplines. Archived physics materials outnumber the other disciplines. Papers from the astrophysics, condensed matter, general relativity, high energy physics, mathematical physics, nonlinear physics, nuclear experiment and theory, and quantum physics fields and subfields are archived[2].

Peer-Reviewed Journals

Applied Thermal Engineering publishes papers surrounding thermal engineering and development of various processes. This includes components and equipment like heat exchangres and pumps, clean renewable energy like solar plants and battery fuel cell management, and industry and building system design. The journal is published by Elsevier monthly online[3].

Fusion Engineering and Design publishes papers about magnetic and internal fusion energy, plasma and technology experiments, theory, models, and methods with emphasis on fusion nuclear technologies, materials, reactor plasmas, fuel cycle analysis, tritium reprocessing, and waste management. The journal is published by Elsevier monthly online[4].

Energy Conversion and Management publishes research on energy. This includes energy generation, usage, storage, conservation, management, and sustainability. Mechanical, thermal, nuclear, chemical, electromagnetic, electric, solar, bio, hydro, wind, geothermal, nuclear, and fossil fuels are included. The journal is published by Elsevier semimonthly online[5].

Area of Interest: Helium Reactors

Helium reactors use helium as a coolant instead of water. They are potentially safer and generate more power than water cooled reactors[6].

Research is ongoing to maximize efficiency and minimize thermal waste[1].

Peer Reviewed Articles

Yari and Mahmoudi researched powering organic Rankine cycles (ORC) using gas turbine-modular helium reactors (GT-MHR) waste heat. ORC converts low to medium thermal energy into electricity like steam plants using organic working fluid not water. The system requires less maintenance and has greater efficiency. The combined GT-MHR/ORC cycle was thermodynamically analyzed for efficiency. Results showed the combination decreases the ***exergy*** destruction rate. Exergy is energy not lost to the surroundings[1].

Şahin and Akbayir researched how flow rate and coolant temperature affect GT-MHR. Helium reactors operate at higher temperatures than water cooled reactors because helium is an inert gas. The graphite core is safe at high temperatures because it has high heat capacity, slow thermal response, and structural stability. If cooling systems malfunction, heat generated from core decay is transferred to reactor cavity cooling system (RCCS). Results state that for original operating conditions outlet temperature and maximum fuel and vessel temperature are obtained at 1122K, 1331K, and 758K. Accident conditions were not considered[6].

Sánchez, Juárez, Sanz, and Perlado analyzed using helium Brayton cycles for high powered energy laser research (HiPER). They conclude a heating process with adequate parameters for reheating and compression should be included to increase efficiency. The most relevant parameter impacting thermal efficiency is maximum temperature. Results indicate the helium Brayton cycle is a candidate for HiPER power cycle because it has higher thermal efficiency than ORC[7].

Conclusion

Advancements made in thermodynamic processes for helium reactors can be applied to other physics research, like HiPER planning to produce electric power through direct-drive internal confinement fusion[7]. Helium reactors provide clean, relatively safe energy with a smaller carbon footprint than fossil fuels[6].

References

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